$$E_L = \frac{1}{2}Li^2 = \frac{1}{2}L(C.\frac{du_C}{dt})^2 = \frac{1}{2}LC^2(\frac{du_C}{dt})^2$$

$$E = \frac{1}{2}LC^2(\frac{du_c}{dt})^2 + \frac{1}{2}C.u_C^2$$

$$* \frac{dE}{dt} = LC^2 \frac{du_c}{dt}.\frac{d^2u_c}{dt^2} + C.u_c.\frac{du_c}{dt}$$

$$= C\frac{du_c}{dt}(\underbrace{LC\frac{d^2u_c}{dt^2} + u_c}_{=0})$$

équation différentielle

$\frac{dE}{dt} = 0 \Rightarrow \Delta E = 0 \Rightarrow E = C^{te}\ \forall t \Rightarrow$ oscillateur non amorti

3°)

a-

* $E = 5.10^{-4}J$

* $U_{cm}^2 = 100V^2 \Rightarrow U_{cm} = 10V$

* $E = \frac{1}{2}C.U_{cm}^2 \Rightarrow C = \frac{2E}{U_{cm}^2} = \frac{2x5.10^{-4}}{100} \Rightarrow C = 10^{-5}F$

b-

* pour $U_c = 0 \Rightarrow E_L = E_{L\,max} = E \Rightarrow E_L = 5.10^{-4}J$

* pour $U_c = 5\sqrt{2}V \Rightarrow E_L = E - E_e = E - \frac{1}{2}Cu_c^2$

$$E_L = 5.10^{-4} - \frac{1}{2}x10^{-5}(5\sqrt{2})^2 \Rightarrow E_L = 2,5.10^{-4}J$$

* pour $u_c = 10V = U_{c\,max} \Rightarrow i = 0 \Rightarrow E_L = 0$

4°)

a- $N = \frac{1}{T}$ or $T = 8ms \Rightarrow N = \frac{1}{8.10^{-3}} \Rightarrow N = 1250Hz$

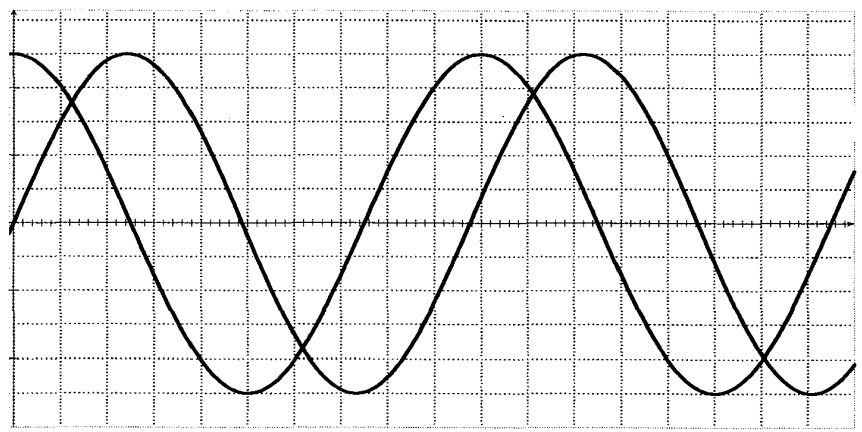
b- * $q(t) = Q_m\sin(\omega_0 t + \varphi_q) = C.U_{Cm}\sin(\omega_0 t + \varphi_{Ucm})$

avec $Q_m = C.U_{cm} = 10^{-4}C$

* $\omega_0 = 2\pi N = 2,5\pi.10^3\,rad.s^{-1}$

* à $t = 0$ on a : $u_c(0) = 0 \Rightarrow q(0) = 0$

$$\rightarrow \begin{cases} \sin\varphi_q = 0 \\ \cos\varphi_q > 0 \text{ (courbe croissante)} \end{cases} \Rightarrow \varphi_q = 0\ rad$$

$$\Rightarrow q(t) = 10^{-4}\sin(2,5\pi10^3.t) \quad (C)$$

$$* \ i(t) = \frac{dq}{dt} \Rightarrow i(t) = 0,25\pi\sin(2,5.10^3\pi t + \frac{\pi}{2})$$